The Effect of Cold Work on the Transformation of the Gamma-Phase into the Sigma-Phase in Austenitic Steel Welds

from the welds after their **age ing** in the course of 25 hours already disclosed the appearance of the sigma-phase. Particles of the sigma-phase were found with the aid of electronic microscope on the borders of austenitic grains. The cold work which proceeds the isothermic heating speeds up the formation of the sigmaphase in austenitic steel welds. Acceleration of the transformation of the gamma-phase into the sigma-phase of the cold-worked steel is intimately linked with the processes of recrystallization. If the deformation grade and the temperature of **ageing** are such that the recrystallization does not take place, the speeding-up action of cold work is not manifested. If the age-**ing** passes at a comparatively low temperature, the sigma-phase appears in the form of grains having the perlite structure. There are 1 graph, 1 table, 7 photographs and 10 references, 3 of which are American

SOV/125-59-7-9/19

The Effect of Cold Work on the Transformation of the Gamma-Phase into the Sigma-Phase in Austenitic Steel Welds

and 7 Soviet

ASSOCIATION: Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki imeni Ye.O. Patona AN USSR (Order of the Red Banner of Labor. Institute of Electric Welding, AS UkrSSR, imeni Ye.O. Patona).

SUBMITTED: February 27, 1959

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SOV/125-59-8-7/18

18(5,7)
AUTHOR: Medovar, B.I.

TITLE: On the Question of the Nature of Crystallization Cracks in Welding Austenitic Steels and Alloys

PERIODICAL: Avtomaticheskaya svarka, 1959, Nr 8, pp 57-66 (USSR)

ABSTRACT: This article deals with the question of the nature of crystallization cracks in welds on austenitic steels and alloys in the light of the literary and the experimental data. The author notes that means for combatting crystallization cracks in welded seams are known for the widely used types of austenitic steels, and that a general theory on the hot cracking of austenitic welded seams has been created. This theory, he says, views the appearance of crystallization cracks as a result of the interaction of two factors - the metallurgical and the force factors, briefly outlined, and for convenience named the theory of molten strata. The most effective means of preventing cracks in austenitic welded seams is the creation of conditions for the appearance of the second phase in the process of

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On the Question of the Nature of Crystallization Cracks in Welding Austenitic Steels and Alloys

primary crystallization of the weld "bath". Or, not resorting to this means, ridding the seam metal of admixtures such as phosphor, silicon, sulphur, arsenic, boron, and tin is also effective. Still another effective means is the additional alloying of the seams with manganese, molybdenum, and tungsten, using a welding wire of type 2Kh25N15G7 or Kh16N26M6 (EI395) steel of a nickel-chrome alloy with 18% tungsten (VZh-98, etc.). The author referes to works by B.A. Movchan and L.A. Poznyak [Ref 10], and Movchan [Ref 1], and Movchan and I.Ya. Dzykovich [Ref 11], who take exception to the theory of molten strata, noting briefly their theses on the subject of hot crack formation. The author dwells on the question of "polygonization" - term used by Movchan, and originally introduced by Orovan and Kan - used to describe the phenomenon of the fragmentation of the metal (alloy) grain, when subjected to high temperatures (below crystallization and deformation temperatures, however). Polygonization

On the Question of the Nature of Crystallization Cracks in Welding Austenitic Steels and Alloys

is further discussed from the points of view of Kotrell, I.A. Oding and V.N. Geminov. Briefly discussing discontinuities between adjacent crystals (hot cracks), the author states that polygonization, rather than being a factor in the formation of cracks, is secondary to the formation of the above discontinuities. The author further dwells on polygonization and crack formation, underlining the absence of a substantial link between the two. Adding molybdenum and tungsten to nickel base alloys increases the resistance of single-phase seams to the formation of hot cracks; thus welding of the nickel-tungsten alloy VZh-98 (nickel base 18%W) by all known methods produced not hot cracks. VZh-98 is thus used in welding austenitic steels disposed to hot cracking (e.g. using VZh-98, type EI696 steel, which normally welds badly, was welded without the formation of cracks). Welding wire Khl6N26 (6-8% Mo) permits making a pure austenitic seam without cracks, and the addition of manganese to the metal of

the seam has a similarly favorable effect. A series of tests with single-phase steel type Kh23N18 (EI417) and Sv-Kh25N20 wire with non-oxygen fluorite flux (ANF-5) were made to test the effect of welding speed variations on hot crack formation; in some of the tests the welding was done with heating up to 800-900°. Speed was varied from 15 to 100 m/hr. Crack formation intensified with increasing speed, but welding with the application of heat produced no cracks. Further tests showed that the introduction of minute quantities of elements such as boron or phosphor into seams welded with VZh-98 and EI395 wire leads to the appearance of hot cracks in the seam metal. Similar work, using EI395 wire and ANF-5 flux, by K.V. Lyubavskiy and V. A. Toropov [Ref 2] referred to by the author supports his conclusions. In conclusion the author discusses briefly two recommendations for combatting hot crack formation by Movchan [Ref 1]: a) additional alloying of the pure austenitic seam with elements which in-

On the Question of the Nature of Crystallization Cracks in Welding Austenitic Steels and Alloys

crease the energy of activation of self-diffusion (molybdenum, tungsten), and b) decreasing the overheating of the weld "bath" in so far as this decreases the overall quantity of defects in the hard phase. The first is already used in practice, but needs further study, especially in regard to the effects of these elements on the polygonization process. The second the author finds "interesting", but also in need of further study with regard to its effect on polygonization. There are 10 photographs, 1 diagram, and 20 references, 17 of which are Soviet and 3 English.

ASSOCIATION: Ordena trudovogo krasnogo znameni - Institut elektrosvarki imeni Ye.O. Patona AN USSR (Order of the Red Banner of Labor - Institute of Electric Welding imeni Ye.O. Paton, AS UkrSSR)

SUBMITTED: April 10, 1959

18(5) SOV/125-59-9-5/16

AUTHOR: Medovar, B.I., Candidate of Technical Sciences, Safonnikov, A.N., Belkin, Ye.Ya., and Sharov, O.A., Engineers

TITLE: Electric Welding under Slag of Agening Chrome-Nickel-Aluminum Stainless Steel

PERIODICAL: Avtomaticheskaya svarka, 1959, Nr 9, pp 33-44 (USSR)

ABSTRACT: Precipitation-hardening stainless steels, such as chrome-nickel austenitic steels possessing high plastic qualities, have a comparatively low strength limit; the latter property hampers their use, in cases where constructions must have a minimum weight at the maximum strength. Research has disclosed that the most efficient method to augment their strength is the creation of martensite in their structure. In the Soviet Union, the chrome-nickel-aluminum stainless steel, Type Kh 15N9Yu make SN-2 or EI904, is widely used. The transformation of austenite to martensite in steel SN-2 is realized by cold-treatment (4 hours at -50°C or 2 hours at -79°C). This process leads to a considerable

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Electric Welding under Slag of Agening Chrome-Nickel-Aluminum Stainless Steel

increase in strength, but does not change the steel fluidity limit. The works of A.P. Gulyayev, S.V. Lepnev and Ya.M.Potak maintain that the above properties are specific for transitional stages, that is, in this case for austenitic-martensitic steels. Their fluidity limit is about 40 kg/mm^2, while their strength is 100-200 kg/mm^2. The SN-2 steel is not only austenitic-martensitic; it is, at the same time, a precipitation-hardening steel. On the basis of numerous experiments, two methods for electric welding of SN-2 steel were accepted for general use: 1) Welding by means of electrode made of SN-2 steel (same as the base material) under application of flux ANF-7 (CaF_2 - CaO) and using obligatory pre-heating, and 2) welding without pre-heating, applying a new fluoride flux ANF-14 (65% CaF_2, 16% SiO_2, 3% CaO, 6% MgO, and 10% Al_2O_3). Research has disclosed that electric welding of stainless

Electric Welding under Slag of Agening Chrome-Nickel-Aluminum Stainless Steel

chrome-nickel-aluminum steel SN-2 by means of a large section electrode made of the same steel does not eliminate the appearance of non-fused spots, if a fluoride flux with increased aluminum oxide contents is used. The negative influence of aluminum oxide can be entirely neutralized by introduction into the flux of a certain amount of silicon oxide or calcium oxide, separately or combined. There are 3 tables, 1 diagram, 6 photographs and 18 references, 9 of which are Soviet, 6 English, 1 French and 2 German.

ASSOCIATION: 1) Ordena trudovogo krasnogo znameni institut elektrosvarki imeni Ye.O.Patona AN USSR (Order of the Red Banner of Labor Institute of Electric Welding imeni Ye.O. Paton, AS Ukr SSR)(Medovar; Safonnikov);2) Moskovskiy sovnarkhoz (Moscow Sovnarkhoz) (Belkin; Sharov).

SUBMITTED: May 26, 1959

25(1) SOV/125-59-12-12/18

AUTHORS: Medovar, B. I. and Safonnikov, A. N.

TITLE: Electric Slag Welding of Heat-Resistant Chrome Steels with a Plate Electrode

PERIODICAL: Avtomaticheskaya svarka, 1959, Nr 12, pp 80-82 (USSR)

ABSTRACT: The Institut elektrosvarki im. Ye. O. Patona AN UkrSSR (Electric Welding Institute Imeni Ye. O. Paton of the AS UkrSSR) has developed a method of electric slag welding with a plate electrode for heat-resistant chrome steels of the martensite grade, for forgings with 75 x 75 to 220 x 220 mm (steel EI961) and 30 x 30 to 80 x 120 mm (steel EI736) cross sections. Plates 12 to 22 mm thick of the same composition as the forgings were used as filler metal. The recommended welding conditions are given in the table. The method ensures the good quality of the welds, and the metal of the joints is solid, without cracks or pores, or other defects. After a corresponding heat treatment, depending on the grade of steel, the mechanical properties of the weld metal

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Electric Slag Welding of Heat-Resistant Chrome Steels with a Plate Electrode

are as good as those of the basic metal. In cases of especially large cross sections, e.g. 220 x 220 mm, of EI961 steel, a special method of welding should be used to avoid cold cracks. Details of the subject method are given. There are 2 photographs, 1 table and 1 diagram.

SOV/125-12-2-1/14

18(5)

AUTHOR: Medovar, B.I., Safonnikov, A.N., and Lents, R.O.

TITLE: Heat Resistance of Welded Joints of the Nickel-Chrome Alloy Type Kh20N80T3Yu (EI437B) (Zharoprochnost' svarnykh soyedineniy nikelekhromovogo splava tipa Kh20N80T3Yu (EI437B)

PERIODICAL: Avtomaticheskaya Svarka, 1959, Vol 12, Nr 2, pp 3-19 (USSR)

ABSTRACT: It is shown that with automatic electro-arc and electric-bar welding of the alloy EI437B, using fluoride oxygen-free flux, a high degree of heat resistance of the welded joints is achieved: $\sigma \frac{sv}{dl} > 0.85 \div 0.90\ \sigma \frac{om}{dl}$ where sv is the welded joint, om the basemetal, and dl the length; $\sigma \frac{om}{dl}$, $\sigma \frac{sv}{dl}$ are the longitudinal strength of the basic metal and the welded joint respectively). Experimental data are quoted for the influence of the time of heating in the tempering process, and of riveting on the

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Heat Resistance of Welded Joints of the Nickel-Chrome Alloy Type Kh20N80T3Yu (EI437B)

longitudinal strength of welded joints. Nickel-chrome heat-resistant alloys are widely used in the manufacture of gas turbines. It is now necessary to weld forged or rolled parts made of heat-resistant alloys 100-200 mm thick. One such alloy is nickel-chrome, type Kh20N80, data for which are given. The hardening qualities of nickel-aluminum-titanium and boron are mentioned. After the USSR developed an oxygen-free fluoride flux, the same type appeared in the USA. The article gives data on the heat-resistance of welded joints of alloy EI437B, 12-20 mm thick, carried out by arc-welding with flux, and up to 100 mm thick carried out by the electric-bar method. A section deals with the heat-resistance of welded joints in alloy EI437B made by the arc method, and is followed by examination of joints of the same alloy welded by the electric-bar method. Engineer V.A. Smirnov took part in the compilation of this section. The important conclusions are that: when welding using flux of the alloy EI437B, 10-20 mm thick and wire EI437A,

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Heat Resistance of Welded Joints of the Nickel-Chrome Alloy Type Kh20N80T3Yu (EI437B)

the longitudinal strength of the welded joint is not less than 80-85% of the strength of the basic metal. Secondly electric-bar welding with a lamellated electrode of heat-resistant alloys on nickel-chrome base, using oxygen-free fluoride flux, gives a high degree of heat-resistance to the joints ($\sigma \frac{sv}{dl} = 0.9 \frac{om}{dl}$). For explanation of symbols, see above. Thirdly there is reason to think that a high degree of heat-resistance for welded joints of alloy EI437B up to 20 mm thick can be achieved even with some reduction of the length of heating during tempering. Preliminary riveting of welded joints before tempering leads to some increase in heat-resistance. There are 11 tables, 2 graphs, 7 drawings and 17 references, 10 of which are Soviet and 7 English.

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SOV/125-12-2-1/14

Heat Resistance of Welded Joints of the Nickel-Chrome Alloy Type Kh20N80T3Yu (EI437B)

ASSOCIATION: Ordena trudovogo krasnogo znameni institut elektrosvarki imeni Ye.O.Patona AN USSR (Order of the Red Banner of Labor Institute of Electric Welding imeni Ye.O.Paton of the AS UkrSSR)

SUBMITTED: November 30, 1958

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SOV/125-12-2-13/14

18(5)
AUTHOR: Medovar, B.I., Safonnikov, A.N., and Puzrin, L.G.

TITLE: Automatic Welding of Chrome-Nickel Stable Austenite Steels, Using an Unprotected Arc (Avtomaticheskaya svarka nezashchishchennoy dugoy khromonikelevykh stabil'noaustenitnykh staley)

PERIODICAL: Avtomaticheskaya svarka, 1959, Vol 12, Nr 2, pp 94-95 (USSR)

ABSTRACT: Research by the Welding Institute has made it possible to perform automatic welding of these steels using a naked electrode and an unprotected arc. As an austenizer, nitrogen is 30 times stronger than nickel. As a result the joint may acquire a pure austenite structure and lose the necessary resistance to heat cracks and intercrystalline corrosion. Consequently it is not recommended that austenite steels of the type 18-8 should be welded with an unprotected arc. For welding the stable austenite steels 25-20, 15-35, 15-20 etc, wires are used which ensure single phase austenite welds or two-phase welds without

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Automatic Welding of Chrome-Nickel Stable Austenite Steels, Using an Unprotected Arc

ferrite. These wires have a reduced silicon content and very little sulphur or phosphorus. On the other hand they have increased concentrations of carbon and manganese. In welding stable austenite salts with wires of these types there is no need to fear the atmospheric oxygen or nitrogen. The nitrogen content of the weld is increased, for example, from 0.008 to 0.012%. Using an unprotected arc there is a sharp reduction in the hydrogen concentration in the weld. Hydrogen can cause heat cracks in pure austenite welds. Trials for prolonged strength (700°, 12 Kgs/mm^2) showed that samples welded with flux collapsed after 45-50 hours, whereas welded in air they lasted 360-370 hrs. Comparative durability tests on flat welded steel samples of EI417 1.5 mm thick were made. Welded using an argon arc and wire 2Kh25N15G7 1.5 mm in diameter, the samples collapsed after 46 hrs at 800° and 4 Kgs/mm^2. Air-welded samples in the same conditions lasted 230 hrs. The authors think that naked wire welding with an unprotected arc of stable austenite

Automatic Welding of Chrome-Nickel Stable Austenite Steels, Using an Unprotected Arc

steels will be used in practice because of its simplicity. For open arc welding, normal welding heads with constant speed electrode supply and the normal generators for flux welding can be successfully used.

ASSOCIATION: Ordena trudovogo krasnogo znameni institut elektrosvarki imeni Ye.O.Patona AN USSR (Order of the Red Banner of Labor Institute of Electric Welding imeni Ye.O.Paton of the AS UkrSSR)

SUBMITTED: December 17, 1958

SOV/125-59-3-5/13

18(5),25(5)

AUTHOR: Latash, Yu.V , and Medovar, B.I.

TITLE: Permeability of the Slag in Electric Welding (O gazopronitsayemosti svarochnykh shlakov pri elektroshlakovom protsesse)

PERIODICAL: Avtomaticheskaya svarka, 1959, Vol 12, Nr 3, pp 45-50 (USSR)

ABSTRACT: This article refers to results of the penetration of hydrogen through the slag of steel 1Kh18N9T , in the process of electric welding, and investigates the use of different types of flux. It emerges that with the hydrogen penetrating into the metal, the amount of titanium residue increases. The probable formulae for this oxidation are given under (2) and (3). Then the interrelation between the hydrogen content of the various types of flux (compiled in Tab. 1) and the titanium content of the metals in question are dealt with. The permeability was measured in atmospheric air, Argon and saturated vapor of H_2O. (Tab. 2 and Fig. 2). The result showed the low-

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est permeability for silicate flux (AN8) and a high degree of permeability for ANF 7. There are 4 tables, 1 graph and 11 references, 10 of which are Soviet and 1 German.

ASSOCIATION: Ordena trudovogo krasnogo znameni institut elektrosvarki im. Ye. O. Patona AN USSR (Order of the Red Banner of Labor Institute for Electro-Welding im. Ye. O. Paton, AS UkrSSR)

SUBMITTED: November 22, 1958

ZHEMCHUZHNIKOV, Georgiy Vladimirovich; PATON, B.Ye., otv.red.; ASNIS, A.Ye., red.; KAZIMIROV, A.A., red.; MEDOVAR, B.I., red.; PODGAYETSKIY, V.V., red.; MANDEL'BERG, S.L., kand.tekhn.nauk, red. MAYEVSKIY, V.V., red.; GORNOSTAYPOL'SKAYA, M.S., tekhn.red.

[Welding of metal structures] Svarka metallokonstruktsii. Moskva, Gos.nauchno-tekhn.izd-vo mashinostroit.lit-ry, 1960. 73 p. (MIRA 14:1)

(Structural frames--Welding)

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S/137/61/000/002/013/046
A006/A001

Translation from: Referativnyy zhurnal, Metallurgiya, 1961, No. 2, p. 9, # 2E66

AUTHORS: Medovar, B.I., Langer, N.A., Kurtepov, M.M.

TITLE: Intercrystalline Corrosion Concentrated Along the Fusion Line in Weld Joints of Stabilized 18-18 Type Steels (Edge-Corrosion)

PERIODICAL: V sb.: "Mezhkristallitn. korroziya i korroziya metallov v napryazh. sostoyanii", Moscow, Mashgiz, 1960, pp. 59 - 70

TEXT: The basic cause for the formation of edge corrosion in weld joints of 1Kh18N9T (1Kh18N9T), 1Kh18N12M2T (1Kh18N12M2T) and Kh18N11B (Kh18N11B) steels, is the dissolving of Ti or Nb+Ta carbides in the austenite, resulting from the heating up of the base metal to > 1,300°C and the subsequent singling out of Cr carbides along the austenitic grain boundaries. The singling out of carbides and the impoverishment of boundary areas of Cr-austenite takes place either during slow cooling or at repeated heating up to the seam-adjacent zone to > 650°C. To

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Intercrystalline Corrosion Concentrated Along the Fusion Line in Weld Joints of Stabilized 18-18 Type Steels (Edge-Corrosion)

prevent edge corrosion, it is necessary to raise the Ti content and the Nb+Ta content in stainless steel; to use low-carbon 18-18 type steels; not to arrange the seams close to each other, in order to prevent secondary heat effects on the seam-adjacent metal; to treat the welds by stabilizing annealing. There are 23 references.

Yu. S.

Translator's note: This is the full translation of the original Russian abstract.

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POTAP'YEVSKIY, Arkadiy Grigor'yevich; PATON, B.Ye., otv.red.; ASNIS, A.Ye., red.; KAZIMIROV, A.A., red.; MEDOVAR, B.I., red.; PODGAYETSKIY, V.V., red.; ZAHUBA, I.I., kand.tekhn.nauk, red.vypuska; MAYEVSKIY, V.V., inzh., red.; GORNOSTAYPOL'SKAYA, M.S., tekhn.red.

[Welding in a protective atmosphere] Svarka v zashchitnykh gazakh. Moskva, Gos.nauchno-tekhn.izd-vo mashinostroit.lit-ry, 1960. 97 p. (MIRA 13:9)

(Welding) (Protective atmospheres)

MEDOYAR, B.I.

PHASE I BOOK EXPLOITATION SOV/5078

Akademiya nauk URSR, Kiyev. Instytut elektrozvaryuvannya

Vnedreniye novykh sposobov svarki v promyshlennost'; sbornik statey. vyp. 3. (Introduction of New Welding Methods in Industry; Collection of Articles. v. 3) Kiyev, Gos. izd-vo tekhn. lit-ry UkrSSR, 1960. 207 p. 5,000 copies printed.

Sponsoring Agency: Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki imeni akademika Ye. O. Patona Akademii nauk Ukrainskoy SSR.

Ed.: M. Pisarenko; Tech. Ed.: S. Matusevich.

PURPOSE: This collection of articles is intended for personnel in the welding industry.

COVERAGE: The articles deal with the combined experience of the Institut elektrosvarki imeni Ye. O. Patona (Electric Welding Institute imeni Ye. O. Paton) and several industrial enterprises in solving scientific and engineering problems in welding technology. Problems in the application of new methods of mechanized welding and electroslag welding in industry are discussed. This is the third collection of articles published under the same title. The Foreword was written by B. Ye. Paton, Academician of the Academy of Sciences Ukrainian SSR and Lenin prize winner. There are no references.

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PHASE I BOOK EXPLOITATION SOV/5078

Akademiya nauk UkSSR, Kiyev. Instytut elektrozvaryuvannya

Vnedreniye novykh sposobov svarki v promyshlennost'; sbornik statey. vyp. 3. (Introduction of New Welding Methods in Industry; Collection of Articles. v. 3) Kiyev, Gos. izd-vo tekhn. lit-ry UkrSSR, 1960. 207 p. 5,000 copies printed.

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MEDOVAR, B.I.

PHASE I BOOK EXPLOITATION SOV/3791

Soveshchaniye po obrabotke zharoprochnykh splavov, Moscow, 1957.

Obrabotka zharoprochnykh splavov; [sbornik dokladov...] (Treatment of Heat-Resistant Alloys; Collection of Papers Read at the Conference), Moscow, Izd-vo AN SSSR, 1960. 231 p. 3,500 copies printed.

Sponsoring Agencies: Akademiya nauk SSSR. Institut mashinovedeniya. Komissiya po tekhnologii mashinostroyeniya; Akademiya nauk SSSR. Institut metallurgii im. A.A. Baykova. Nauchnyy sovet po problemam zharoprochnykh splavov.

Resp. Ed.: V.I. Dikushin, Academician; Ed. of Publishing House: V.A. Kotov; Tech. Ed.: V.V. Bruzgul'.

PURPOSE: This book is intended for metallurgists.

COVERAGE: The book consists of thirty papers read at the Conference on the Treatment of Heat-Resistant Alloys held in Moscow by the Committee on Machine-Building Technology, Institute of the Science of Machines, Academy of Sciences USSR, in 1957. The papers deal with four principal areas of alloy metallurgy: casting, forming, machining, and welding. The alloys (together with refractory carbides, borides, nitrides, and oxides) are discussed especially in connection with their application in the manufacture of turbine blades, heat engines, boilers, reactors, containers for high-temperature media, dies, casting molds, and metal-cutting tools. No personalities are mentioned. Some of the articles are accompanied by references, mainly Soviet.

MEDOVAR, B.I.

PHASE I BOOK EXPLOITATION SOV/4343

Soveshchaniye po teorii liteynykh protsessov, 3d

Usadochnyye protsessy v metallakh; trudy soveshchaniya (Shrinkage Processes in Metals; Transactions of the Third Conference on the Theory of Casting Processes) Moscow, AN SSSR, 1960. 281 p. Errata slip inserted. 3,000 copies printed.

Sponsoring Agency: Akademiya nauk SSSR. Institut mashinovedeniya. Komissiya po tekhnologii mashinostroyeniya.

Resp. Ed.: B.B. Gulyayev, Doctor of Technical Sciences, Professor; Ed. of Publishing House: V.S. Rzheznikov; Tech. Ed.: T.V. Polyakova.

PURPOSE: This collection of articles is intended for scientific workers, engineers, technicians of scientific research institutes and industrial plants, and for faculty members of schools of higher education.

COVERAGE: The collection contains technical papers presented at the Third Conference on the Theory of Casting Processes, organized by Liteynaya sektsiya Komissii po tekhnologii mashinostroyeniya Instituta mashinovedeniya AN SSSR (Casting Section of the Commission for Machine-Building Technology of the Institute of Science of Machines, Academy of Sciences USSR) and by Institut metallurgii imeni Baykova AN SSSR (Institute of Metallurgy imeni A.A. Baykov, Academy of Sciences USSR). The most serious defects in castings, ingots, and welds as a result of metal shrinkage are reviewed. Factors contributing to the formation of shrinkage cavities, porosity, cracks, fissures, distortion, and internal stresses are analyzed along with measures taken to prevent and remedy them. The hydrodynamics of molten metals and the process of solidification of metals are discussed. Also presented are resolutions adopted at the Conference with regard to the problem of shrinkage in metals. No personalities are mentioned. Most papers are accompanied by bibliographic references, the majority of which are Soviet.

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Shrinkage Processes (Cont.) SOV/4343

AVAILABLE: Library of Congress (TS230.S7)

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S/125/60/000/03/010/018
D042/D001

25(1)

AUTHORS: Medovar, B.I. and Yagupol'skaya, L.N.

TITLE: Corrosion Destruction of Butt Welds in Pipes of Stainless 17% Chromium Steel

PERIODICAL: Avtomaticheskaya svarka, 1960, Nr 3, pp 70-74

ABSTRACT: The article describes a case of corrosion breakdown of a coil pipe at a nitric-fertilizer plant. The welded joints started to leak and corrosion could be observed on the body of the pipe on both sides of the joints. The defective joints were covered by unions, but the corrosion set in again. The Institute of Electric Welding imeni Ye.O. Paton investigated this case. It was stated that corrosion was caused on the outside of the pipe coil by the 50% nitric acid content when it was heated to 110° C by the steam inside the coil. The corrosion in the base pipe metal was clearly intercrystalline. The nature of the revealed corrosion is discussed with references to foreign works /Ref. 1 Monypenny;

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S/125/60/000/03/010/018
D042/D001

Corrosion Destruction of Butt Welds in Pipes of Stainless 17% Chromium Steel

4, Lula, Lena, Kiefer] and two Soviet [Ref. 2, 3]. The following practical conclusions were made: "Kh17T" steel should be used and not "Kh17" (in steel with titanium the grain growth in welding is less than in "Kh17" steel). Secondly, if unstabilized steel is used, the welded joints must be subjected to local heat treatment. At the nitric-fertilizer plant both mistakes were committed and unstabilized austenite electrodes were used. The coil pipes of steel "Kh17" can be welded with electrodes "EF17" (GOST 2523-54), i.e. "Kh17" wire, or with austenite "EA1" electrodes which give a stabilized weld metal with a two-phase austenite-ferrite structure resistant to intercrystalline corrosion. Electrodes of "OKh18N9F2C" wire (EI606) or "OKh18N9FBC" wire (EI649) can also be used. In the first case (electrodes EF17), a local heat treatment of the butt welds (e.g. blowpipe) is necessary; in the second case it

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S/125/60/000/03/010/018
D042/D001

Corrosion Destruction of Butt Welds in Pipes of Stainless 17% Chromium Steel

is not mandatory, as the speed of intercrystalline corrosion in the heat-affected zone is comparatively not great. There are 1 diagram, 1 set of diagrams, 2 sets of photographs, 1 photograph, and 6 references, 3 of which are Soviet and 3 English.

ASSOCIATION: Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki im Ye.O. Patona AN USSR (Order of the Red Banner of Labor Institute of Electric Welding imeni Ye.O. Paton AS UkrSSR).

SUBMITTED: October 21, 1959

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14(5), 25(1)

S/125/60/000/04/003/018
D042/D006

AUTHORS: Medovar, B.I. and Maksimovich, B.I.

TITLE: A New Method of Refining Fluorspar and Fluorine Welding Fluxes

PERIODICAL: Avtomaticheskaya svarka, 1960, Nr 4, pp 13-21 (USSR)

ABSTRACT: A new method (Authors' Certificate No 122563 effective 16 March, 1959) has been developed for refining fluorspar (fluorite concentrate) in which it is smelted in an electric furnace and is maintained for a certain time in liquid condition. After refining a sharp decrease is obtained in the content of sulfur and unstable oxides (SiO_2, FeO). Oxygen-free fluxes for welding high alloy steels and alloys (series ANF) proposed by Institute of Electric Welding [47], contain 50 - 100% calcium fluoride. The

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A New Method of Refining Fluorspar and Fluorine Welding Fluxes

same applies to fluxes for the electroslag smelting of steels and alloys [5]. The basic component of the charge of ceramic fluxes, developed recently at TsNIITMASh for welding alloyed steels, also consists of fluorines - calcium fluoride and sodium [6]. Ordinary ceramic fluxes contain 10-20% CaF_2 [7].

GOST"4421-48" standard fluorspar must have not less than 92% CaF_2, not more than 5% SiO_2, not more than 0.1% S, with traces of phosphorus only. According to "TsMTU 1187-45" fluorite concentrate must not contain more than 2% S and 1.5% SiO_2 when CaF_2 $>$ 95%. In fact fluorite concentrate, e.g. from the Takobskiy (Takob) deposit (Uzbekskaya SSR),

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A New Method of Refining Fluorspar and Fluorine Welding Fluxes

often contains 0.5% S. Using the new method of smelting fluorine welding fluxes or fluxes with an increased content of calcium fluoride even with a low-grade raw material (fluorspar, fluorite concentrate) it is possible to obtain a product with an exceptionally low content of sulfur, and ferric and silicon oxides. This method consists in the separate loading of the charge materials into the furnace. First, the fluorspar (fluorite concentrate) is smelted and kept for some time in a liquid condition, i.e. it is refined, then the rest of the charge is loaded into the furnace. This method of refining fluorspar (fluorite concentrate) can prove useful to enterprises which make electrodes with a basic coating for arc welding. There are 6 tables, 1 photograph, 1 graph,

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A New Method of Refining Fluorspar and Fluorine Welding Fluxes

and 13 references, 12 of which are Soviet and 1 English.

ASSOCIATION: Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki im. Ye.O. Patona An USSR (Order of the Red Banner of Labor Institute of Electric Welding imeni Ye.O. Paton AS UkrSSR).

SUBMITTED: October 31, 1959

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80824
S/125/60/000/06/07/007

18.7200

AUTHORS: Medovar, B.I., and Safonnikov, A.N.

TITLE: Electroslag Welding of ЭИ 654 (EI654) Steel

PERIODICAL: Avtomaticheskaya svarka, 1960, No. 6, pp 82 - 84

TEXT: Institut elektrosvarki im.Ye.O.Patona (Electric Welding Institute imeni Ye.O.Paton) of AN USSR (AS UkrSSR) developed a new electroslag welding technology, with the use of a "plate electrode", for stainless high-strength "EI654" steel in thicknesses up to 65 mm and a cross section area up to 5,000 mm^2 forged or rolled. The plate electrodes are forged from the same steel grade into corresponding width. The recommended welding process parameters (Table 1) give a highly stable welding process. They are: Current 1,350 amp for 35 x 60 mm cross section, and 1,800 amp for 65 x 80 mm cross section; 25 volt; electrode feed of 2.0 m/h; a gap of 30 mm; АНФ -14 (ANF-14) flux; welding pool depth 10 mm and 12 mm respectively. Welding can also be done under АНФ-7 (ANF-7) flux, but it is highly hygroscopic and must therefore be preliminarily roasted in a temperature not lower than 800°C. The effect of heat treatment was investigated. The data (Table 2) proved that quenching practically did not affect the mechanical strength of the joint but affected the impact resistance, which increased considerably when

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Electroslag Welding of ЭИ 654 (EI654) Steel S/125/60/000/06/07/007

the quenching temperature was raised from 900 to 1,100°C. Quenching at 900°C (with 1, 2 and 3 hours holding this temperature) abruptly reduced the plasticity of the welding metal and of the whole joint. Quenching temperature of up to 1,100°C reduced the yield point, and with the ultimate strength remaining constant this led to higher plasticity of the metal and of the joint in general. There are 2 tables and 1 graph.

4

B/125/60/000/009/003/017
A161/A130

18 3200

AUTHORS: Latash, Yu.V., Maksimovich, B.I., Medover, B.I., Klyuyev, M.M., Topilin, V.V.

TITLE: Elimination of Non-Metallic Inclusions from Metal in the Electro-Slag Remelting Process

PERIODICAL: Avtomaticheskaya svarka, 1960, No. 9, pp. 17-23

TEXT: As known from previous works, treatment with slag in the electro-slag remelting process reduces the sulfur content (Ref. 5, 6), and the quantity of sulfide inclusions drastically decreases (Ref. 3, 4). Experiments have been carried out by the Electric Welding Institute at the "Dneprospetsstal" Plant to investigate the effect of flux composition and properties in the electro-slag remelting of ball bearing steel grade ШХ15СГ (ShKh15SG). (The initial metal had been highly contaminated.) Three steel rods of 85 mm diameter each were joined into a bunch and melted as electrodes in a water-cooled copper ingot mold of 260 mm diameter. The composition of the three

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Elimination of Non-Metallic Inclusions from Metal in the Electro-Slag Remelting Process

different fluxes used is the following:

		CaF_2 %	CaO %	Al_2O_3 %
AHФ-1П	(ANF-1P)	Bulk	5	30
AHФ-6	(ANF-6)	65	5	55
AH-29	(AN-29)	-	45	-

Eleven ingots of 310 to 320 kg were cast. Due to the difference in conductivity of the flux grades (lowest in AN-29) the melting rate was different (Table 2). It is emphasized that in the case of the watched ingot diameter (260 mm), the growing melting speed is accompanied by a change of grain growth direction, and the axial growth is gradually replaced by radial growth. The degree of purification from sulfides increased in the order ANF-1P, ANF-6, AN-29 flux, i.e., the highest purification was obtained with the AN-29 which had the highest CaO content. The better effect of ANF-6 than of

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A161/A130

Elimination of Non-Metallic Inclusions from Metal in the Electro-Slag Remelting Process

ANF-1P is explained by its better desulfurizing capacity due to Al_2O_3 lowering the melting point of flux and raising the slag pool temperature. The effect of ANF-1P and ANF-6 on the content of oxides, silicates and globular inclusions was equal, and of the AN-29 weaker (Fig. 2). Non-metallic inclusions rose to the surface in the process, and the top portion of the ingots was contaminated more than the bottom, particularly by globules in remelting with AN-29 flux. The following conclusions were made: 1. It has been proven on the example of ball bearing steel ShKh15G that metal is purified from oxides, silicates and globules mainly due to the inclusions rising to the surface and the purification degree depends on the speed of the ingot formation, i.e., on the speed of the crystallization front motion, and the orientation of the crystal growth (axial or radial). 2. The desulfurization degree depends mainly on the desulfurizing capacity of the flux, and not on the speed of melting. 3. It can be stated that it

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A161/A130

Elimination of Non-Metallic Inclusions from Metal in the Electro-Slag Remelting Process

is possible to obtain ball bearing steel of a particularly high purity from non-metallic inclusions by using the electro-slag remelting process. Such steel is suitable for special small bearings in the most critical applications. Engineer S.A. Leybenzon of "Dneprospetsstal" took part in experiments. There are 5 figures and 12 Soviet references.

ASSOCIATIONS: Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki im. Ye.O. Patona AN USSR (Electric Welding Institute "Order of the Red Banner of Labor" im. Ye.O. Paton of the Academy of Sciences of the UkrSSR) - Yu.V. Latash, B.I. Makelmovich, B.D. Medovar; Ordena Lenina metallurgicheskiy zavod im. I.M. Tevosyana (Metallurgical Plant "Order of Lenin" im. I.M. Tevosyan) - M.M. Klyuyev and V.V. Topilin

SUBMITTED: April 20, 1960

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S/125/60/000/010/002/015
A161/A133

1.2300 also 1045.

AUTHORS: Medovar, B.I., Maksimovich, B.I., Latash, Yu.V., Topilin, V.V., Klyuyev, M.M., Shiryayev, N.A.

TITLE: The Effect of Electro-Slag remelting on the Quality of Stainless 0Х18Н9 (0Kh18N9) and 1Х14Н19В3Б (1Kh14N19V3B)(ЭИ851 (EI851)) Steel

PERIODICAL: Avtomaticheskaya svarka, 1960, No. 10, pp. 11-18

TEXT: The article contains information on experiments with electro-slag remelting process. The material used were bars of 0Х18Н9 (0Kh18N9)steel 100mm in diameter, and ЭИ851 (EI851) steel 85 mm in diameter joined into bundles of three and melted in an ingot mold of 250 mm diameter. Five 300 kg ingots were cast. Two ingots were reforged into a 25x175x515 mm billet, and two into a 95 mm diameter bar; one was investigated as cast. The results of metallographic investigation are presented. There were no streaks, nor nonmetallic inclusion accumulations, and the absolute content of slag inclusions was considerably lower than in the initial metal, which was also confirmed by

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S/125/60/000/010/002/015
A161/A133

The Effect of Electro-Slag Remelting on the Quality of Stainless 0Х18Н9 (OKh18N9) and 1Х14Н19В3Б (1Kh14N19V3B) (ЭИ851 (EI851)) Steel

electro-chemical solving. The total gas content was twice lower than in the initial metal; the nitrogen and oxygen contents were reduced more than the hydrogen content. Apparently, oxygen is being eliminated in the process with floating oxide inclusions, and nitrogen and hydrogen can separate with bubbles forming on the surface of the growing metal grains. Nitrogen separates from metal easily when the metal contains no components forming stable nitrides (titanium, niobium). Nitrides having a higher melting point and larger volume do not coagulate and stick more easily in interaxial spaces. This explains the different quantity of nitrogen eliminated from the two steel grades. The following conclusions are made: 1) The electro-slag process considerably reduces the gas content and nonmetallic inclusions in both steel grades. 2) It raises the ductility of austenitic stainless steel grade and considerably reduces the anisotropy of mechanical properties. 3) The ductility of the remelted metal at hot deformation temperature is 30-40% higher than that of the initial one. There are 8 figures, 5 tables and 5 Soviet-bloc references.

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A161/A133

The Effect of Electro-Slag Remelting on the Quality of Stainless 0Х18Н9 (0Kh18N9) and 1Х14Н19В3Б (1Kh14N19V3B) (ЭИ851 (EI851)) Steel

ASSOCIATIONS: Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki im.Ye. O.Patona AN USSR ("Order of the Red Banner of Labor" Electric Welding Institute im.Ye.O.Paton of the UkrSSR Academy of Sciences) (B.I. Medovar, B.I. Maksimovich and Yu.V. Latash); Ordena Lenina elektrometallurgicheskiy zavod "Elektrostal'" im. I.F.Tevosyana ("Order of Lenin" Electro-Metallurgical "Elektrostal'" Plant im.I.F.Tevosyan) (V.V. Topilin, M.M. Klyuyev and N.A. Shiryayev)

SUBMITTED: May 5, 1960

Card 3/3

S/135/60/000/010/004/015
A006/A001

AUTHOR: Medovar, B. I., Candidate of Technical Sciences

TITLE: Improving the Weldability of Austenitic Steels and Alloys by Electroslag Remelting

PERIODICAL: Svarochnoye proizvodstvo, 1960, No. 10, pp. 16-18

TEXT: The author mentions some methods suggested by K. V. Lyubavskiy, F. I. Paushkanis, A. Ye. Runov, Staufer and Keller, of preventing crack formation in areas adjacent to weld joints in austenitic steels and alloys (changes in the compositon of the base metal, stamping of edges to be welded, hardfacing of edges). In the author's opinion raising the purity and improving the structure of the base metal by electroslag remelting is an effective means against crack formation. This method was developed with the participation of Yu. V. Latash, Cendidate of Technical Sciences, and engineers V. I. Maksimovich, L. V. Chekotilo and L. G. Puzrin, and is described as follows: a large-section consumable electrode is fused in the slag pool formed in a water-cooled metallic crystallyzer closed by a water-cooled bottom plate with feed of current. Non-oxidizing fluoride fluxes, capable of refining the liquid metal, are used as slags.

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S/135/60/000/010/004/015
A006/A001

Improving the Weldability of Austenitic Steels and Alloys by Electroslag Remelting

The presence of a slag layer between the ingot and the crystallizer walls ensures the axial direction of the crystal growth and the absence of casting defects in the ingot metal. This way of crystallization of the liquid metal pool and the presence of a deep slag pool purify the metal from oxidation impurities and gases. As a result highly pure metal is obtained whose composition and structure are homogeneous. Comparison tests made with ЭИ725 (EI725) and ЭИ726 (EI726) steel and ЭИ437Б (EI437B) alloy proved that cracks, when welding remelted steel, were either absent or much shorter than those in the initial metal. It is assumed that a reduction in the boron content caused by electroslag remelting, reduces the danger of crack formation. The author points out that the described method can not be considered as a universal means to prevent the formation of cracks, but that the efficiency of the aforementioned technological methods may be raised when applied to metal that was treated by electroslag remelting. There are 4 figures.

ASSOCIATION: Institut elektrosvarki imeni Ye. O. Patona AN USSR (Institute of Electric Welding imeni Ye. O. Paton AS UkrSSR)

Card 2/2

MEDOVAR, B.I.; SAFONNIKOV, A.N.

Electric slag welding of EI654 steel. Avtom.svar. 13 no.6:82-89 Je '60. (MIRA 13:7)
(Steel—Welding)

MALEVSKIY, Yu.B., MEDOVAR, B.I., MANZHELEY, G.P.

Chemical composition of the σ-phase in 25-20-type austenite welds. Avtom. svar. 13 no.8:33-36 Ag '60. (MIRA 13:8)

1. Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki im. Ye.O. Patona AN USSR.
(Steel--Welding)
(Steel--Analysis)

LATASH, Yu.V.; MAKSIMOVICH, B.I.; MEDOVAR, B.I.; KLYUYEV, M.M.; TOPILIN, V.V.

Metal purification from nonmetallic inclusions in the electric slag-remelting. Avtom. svar. 13 no.9:17-23 S '60. (MIRA 13:10)

1. Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki im. Ye. O. Patona AN USSR (for Latash, Maksimovich, Medovar). 2. Ordena Lenina metallurgicheskiy zavod im. I.M.Tevosyana (for Klyuyev, Topilin).
(Smelting) (Steel--Electrometallurgy)

89715

18.3200
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S/125/60/000/012/008/014
A161/A030

AUTHORS: Medovar, B.I.; Latash, Yu.V.; Maksimovich, B.I.; Stupak, L.M.

TITLE: Electro-Slag Remelting of Steel Alloyed with Readily Oxidizing Elements

PERIODICAL: Avtomaticheskaya svarka, 1960, No. 12, pp. 60 - 65

TEXT: Experiments have been carried out to determine the proper technique for electro-slag remelting of steel containing easily oxidizing components, for the АНФ-6 (ANF-6) flux (of CaF_2-Al_2O_3 system) does not ensure full absorption of some elements. 50% oxidation of titanium in remelting 1Х18Н9Т (1Kh18N9T) steel with this flux is an example. This steel was chosen for the experiments. A water cooled copper mold of 250 mm height and 50 mm inner diameter was used; the 3 mm welding wire was of the same steel. A series of calcium fluoride base fluxes was tested. Process details: melting with alternating current; wire feed 156 m/hr; transformer idle voltage 50 - 54 volt for flux with low conductivity in molten state (the "АН-8" (AN-8) tried for comparison, and fluoride base fluxes with high Al_2O_3 content), and 36 - 38 volts for high-conductive fluxes (pure CaF_2, concentrated fluorite, and their mixtures with SiO_2 and TiO_2); melting current 42-46 volts and 300 - 330 amps for low-conductive flux, and 28 - 32 volts and 360

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Electro-Slag Remelting of Steel Alloyed with Readily Oxidizing Elements

amps for high-conductive. Argon was fed to the bath surface through a special hood (Fig. 1). Ingots were shaved to templates of 20 mm thickness, and the titanium content determined by spectrum analysis. Apparantly, the reason for high titanium oxidation in process with the ANF-6 flux is the content of 2 - 3% SiO_2 in it, originating from the fluorine concentrate and Γ-4 (G-4) alumina used in the making. The burning of titanium dropped when the fluorine concentrate was replaced with pure CaF_2 (Fig. 3), and it dropped more when G - 4 was replaced with pure aluminum oxide. But appearantly Al_2O_3 is not absolutely neutral in the electro-slag process when its content is high, for some reducing of aluminum from such slag had been revealed (Ref. 8) in slag treatment, and it is observed also in electro-slag welding of titanium steel with the ANF-6 flux. The sources of oxygen are the ambient air; higher iron oxides (Refs. 10, 11); Ti oxides in the slag, for titanium can form TiO, Ti_2O_3 and TiO_2 (Ref. 12); scale or rust on the melting electrode, or its oxidation in close vicinity with the bath surface where it is heated to over 800 - 900°C. Argon shielding is an effective means against oxidation of titanium or other oxidizing metals in the process. It is obvious that fluxes containing no unstable oxides must be used and the bath must be shielded from air. As had been stated in (Ref. 14) (B.I. Medovar and B.I. Maksimovich,

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S/125/60/000/012/008/014
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Electro-Slag Remelting of Steel Alloyed with Readily Oxidizing Elements

"Avtomaticheskaya svarka", No. 4, 1960) pure flux for electro-slag remelting of alloys with readily oxidizing components can be obtained by keeping molten flux for a considerable length of time (in the making process) in an arc furnace with graphite electrodes and graphite bottom. The flux is purified from silica and iron oxides through deoxidation by carbon and through the formation of volatile silicon fluorides. The АНФ-1 (ANF-1) flux (fluoride concentrate) refined in this way is near to pure calcium fluoride by the content of unstable oxides and has been given the designation "АНФ-1П" (ANF-1P). The developed processing technique was tested at the "Dneprospetsstal'" works (Engineer S.A. Leybenzon of "Dneprospetsstal'" took part); 300 - 350 kg ingots of 1Kh18N9T steel were melted using pure calcium fluoride and the ANF-1P flux. Apart from this, not fresh but used ANF-1P flux was tried. Argon was used for shielding all the time; the electrodes were carefully cleaned of scale by pickling. The oxidation of titanium was insignificant in all three process variations, but it was slightly higher in the bottom ingot portions after remelting with fresh ANF-1P flux than with pure calcium fluoride. The minimum Ti oxidation was obtained, as expected, with reused ANF-1P. Titanium oxidation was practically absent. There are 3 figures and 14 references of which 13 are Soviet and 1 English.

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89715

S/125/60/000/012/008/014
A161/A030

Electro-Slag Remelting of Steel Alloyed with Readily Oxidizing Elements

ASSOCIATION: Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki im. Ye.O. Patona AN USSR (Electric Welding Institute "Order of the Red Banner of Labor" imeni Ye.O. Paton of the AS UkrSSR)

SUBMITTED: April, 6 1960

Figure 1:

1 - electrode;
2 - slag;
3 - metal

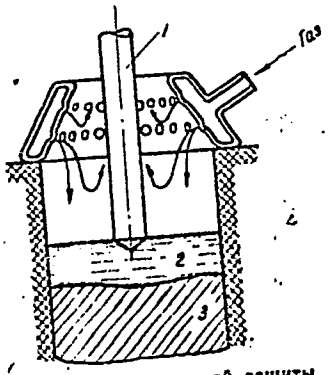

Рис. 1. Схема газовой защиты шлаковой ванны:
1 — электрод; 2 — шлак; 3 — металл.

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A161/A030

Electro-Slag Remelting of Steel Alloyed with Readily Oxidizing Elements

Figure 3:

Assimilation of titanium (in % from 20 to 100) on different levels in the ingot (in mm, from bottom to 200 mm).

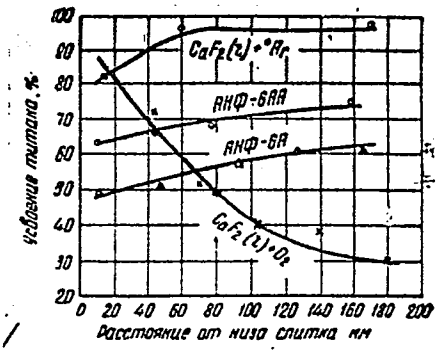

Рис. 3. Усвоение титана по высоте слитка.

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MEDOVAR, B.I. 115

PHASE I BOOK EXPLOITATION SOV/5411

Konferentsiya po fiziko-khimicheskim osnovam proizvodstva stali. 5th, Moscow, 1959.

Fiziko-khimicheskiye osnovy proizvodstva stali; trudy konferentsii (Physicochemical Bases of Steel Making; Transactions of the Fifth Conference on the Physicochemical Bases of Steelmaking) Moscow, Metallurgizdat, 1961. 512 p. Errata slip inserted. 3,700 copies printed.

Sponsoring Agency: Akademiya nauk SSSR. Institut metallurgii imeni A. A. Baykova.

Responsible Ed.: A. M. Samarin, Corresponding Member, Academy of Sciences USSR; Ed. of Publishing House: Ya. D. Rozentsveyg. Tech. Ed.: V. V. Mikhaylova.

Card 1/16

Physicochemical Bases of (Cont.) SOV/5411

PURPOSE: This collection of articles is intended for engineers and technicians of metallurgical and machine-building plants, senior students of schools of higher education, staff members of design bureaus and planning institutes, and scientific research workers.

COVERAGE: The collection contains reports presented at the fifth annual convention devoted to the review of the physicochemical bases of the steelmaking process. These reports deal with problems of the mechanism and kinetics of reactions taking place in the molten metal in steelmaking furnaces. The following are also discussed: problems involved in the production of alloyed steel, the structure of the ingot, the mechanism of solidification, and the converter steelmaking process. The articles contain conclusions drawn from the results of experimental studies, and are accompanied by references of which most are Soviet.

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88250

S/135/61/000/002/001/012
A006/A001

1.2300

AUTHORS: Medovar, B. I., Candidate of Technical Sciences, Puzrin, L. G., Engineer

TITLE: Automatic Submerged Arc Welding of Heat Resistant Austenitic Steels of the X14H18B3BP (Kh14N18V3BR) Type (ЭИ 695Р [EI695R] and ЭИ726 [EI726])

PERIODICAL: Svarochnoye proizvodstvo, 1961, No. 2, pp. 1-4

TEXT: From 1958 to 1960 the Institute of Electric Welding imeni Ye. O. Paton together with TsNIICHM imeni I. P. Bardin, were occupied with the experimental investigation of automatic welding heat-resistant austenitic EI695R and EI726 steels (Composition - Table 1), intended for the production of steam conductors and steam superheaters of power installations operating at superhigh parameters (up to 700°C). The investigation was performed in two directions: a) establishing a technology for automatic subermerged arc welding, eliminating crystallization cracks in the weld metal and simultaneously maintaining a single-phase structure, i. e. without the aid of initial carbides or ferrite; b) research of reliable means preventing the formation of weld-adjacent cracks during submerged arc welding of EI726 steel. To obtain single-phase austenitic welds, resistant to crystallization cracks, it is necessary a) to reduce the silicon content in the weld metal to

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S/135/61/000/002/001/012
A006/A001

Automatic Submerged Arc Welding of Heat Resistant Austenitic Steels of the Х14Н18В3БР (Kh14N18V3BR) Type ЭИ695Р [EI695R] and ЭИ726 [EI726])

0.15 - 0.25%; b) to replace partially nickel by manganese and bring the Mn content up to about 6 - 8%; c) to reduce the phosphorus content; d) to alloy the weld additionally with molybdenum, tungsten, vanadium; e) to use non-oxidizing fluxes; f) either to eliminate boron from the metal composition, or to bring its concentration to a level, making possible the "healing up" of cracks by boride eutectics. On the basis of experiments performed, the Institute developed 4 types of experimental wires having a similar composition as EI695R and EI726 steels. (Table 2). They did not contain boron but increased amounts of manganese and tungsten in the presence of molybdenum. It was found that the endurance strength of metal welded with these wires, was at 700°C (100 hrs) not less than 18 - 20 kg/mm^2, i. e. the same as that of the base metal. (EI726 steel). Using the wires in combination with АНФ-5 (ANF-5) and АНФ-15 (ANF-15) fluxes for welding EI695R steels under laboratory conditions, high quality butt welds were produced without employing any special technological means. The wires are recommended for the industrial testing when welding EI695R steels. The welding of EI726 steels is more difficult due to the proneness of this steel to weld-adjacent cracks. Technological and metallurgical means to prevent this defect did not yield satisfactory

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S/135/61/000/002/001/012
A006/A001

Automatic Submerged Arc Welding of Heat Resistant Austenitic Steels of the X14H18B3BP(Kh14N18V3BR) Type (ЭИ695Р [EI695R] and ЭИ726 [EI726])

results. The Institute developed a new method of improving the quality of steels and alloys by electric slag remelting in a metallic water-cooled crystallizer (See "Avtomaticheskaya svarka", 1958, No. 11). The main advantages of a metal subjected to this process was a reduced content of gases, sulfur, non-metallic impurities, absence of zonal segregation, uniform distribution of alloying elements, uniform grain size. Such properties of the remelt metal assure its improved weldability in respect to higher resistance against the formation of weld-adjacent cracks. Electric-slag remelting of EI726 steel was made using complex means reducing to a minimum the losses of easy oxidizing elements, including boron: at a content of 0.0100% boron in the initial metal, the metal remelted once contained 0.0097% and twice remelted metal contained 0.0084% boron. Endurance strength of remelted metal at 700°C (20 - 30 kg/mm^2) was higher than that of the initial metal (16 - 22 kg/mm^2). The tests have shown that electric slag remelting improved noticeable the weldability of initial EI726 steel. A strictly observed technology, comprising preliminary and associated heating at 400 - 600°C, and accurately maintained welding conditions eliminate weld-adjacent cracks during welding of non-rigid joints of up to 15 mm thick remelted EI726 steel. Relatively slight

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68250

S/135/61/000/002/001/012
A006/A001

Automatic Submerged Arc Welding of Heat Resistant Austenite Steels of the Х14Н18В3БР (Kh14N18V3BR) Type (ЭИ695Р[EI695R] and ЭИ726 [EI726])

deviations from optimum welding conditions, entail the formation of weld-adjacent cracks. EI726 steel is not recommended for using in welded structures.

Table 1

Chemical composition of EI695R and EI726 steels (in %)

Марка стали, Steel grade	C	Si	Mn	Cr	Ni	W	Nb	B	S	P
ЭИ695Р	0,07—0,12	<0,6	1,0—2,0	13,0—15,0	18,0—20,0	2,0—2,75	0,9—1,3	0,005	0,025	0,035
ЭИ726	0,07—0,12	<0,6	1,0—2,0	13,0—15,0	18,0—20,0	2,0—2,75	0,9—1,3	0,025	0,025	0,035

Table 2

Chemical composition of wires (in %)

Марки проволоки Wire grades	No. № of плавок melts	C	Si	Mn	Cr	Ni	W	Nb	B	Mo	Ti	S
Х14Н20Г8М8В3Б (1)	9-8423	0,05	0,3	8,1	13,74	19,15	2,84	1,29	None Нет	7,5	None Нет	0,012
Х14Н20Г8В6М3Б (2)	9-8424	0,04	0,25	8,0	13,46	22,84	6,01	1,17	"	3,3	"	0,020
Х14Н20Г8В8М3Т (3)	9-8425	0,04	0,19	8,0	14,11	19,22	7,68	Нет	"	3,32	0,95	0,020
Х14Н20Г8В8Т (4)	9-8426	0,04	0,18	7,9	13,79	19,29	7,90	"	"	Нет	0,92	0,013

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88250

S/135/61/000/002/001/012
A004/A001

Automatic Submerged Arc Welding of Heat Resistant Austenitic Steels of the Х14Н18В3БР (Kh14N18V3BR) Type (ЭИ695Р [EI695R] and ЭИ726 [EI726])

(1) - Kh14N20G8M8V3B; (2) - Kh14N20G8V6M3B; (3) - Kh14N20G8V8M3T; (4) - Kh14N20G8V8T.
There are 2 tables, 6 figures and 3 Soviet references.

ASSOCIATION: Institute elektrosvarki imeni Ye. O. Patona AN USSR (Institute of Electric Welding imeni Ye. O. Paton, AS UkrSSR)

Card 5/5

22952
S/125/61/000/007/008/013
D040/D113

1-2310

AUTHORS: Medovar, B.I.; Nazarenko, O.K.; Gurevich, S.M.; Chekotilo, L.V.; Povod, A.G.; and Pinchuk, N.I.

TITLE: Some peculiarities of electron-beam welding of austenitic steels and alloys

PERIODICAL: Avtomaticheskaya svarka, no. 7, 1961, 79-81

TEXT: In their introductory remarks, the authors state why the electron-beam welding of austenitic steels and alloys in a vacuum is superior to conventional welding. For experimental purposes, specimens of ЭИ 726 (EI 726) and ЭИ696 (EI 696) heat-resistant austenitic steels and a nimonic-type ЭИ 437Б (EI437B) alloy were welded by the electron-beam method. All these types contain boron and are prone to cracks in the area near the weld and in the weld metal, if the compositon of the base metal is reproduced. Welding was carried out with an electron-beam gun designed by the Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki im. Ye.O. Patona AN USSR (Electric Welding Institute "Order of the Red Banner of Labor" im. Ye.O. Paton AS UkrSSR) using 120 mA, 20 kw current and a 35 m/hr welding speed. Metal

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Some peculiarities of electron-beam ...

produced by the electron beam was completely sound, except in the case of EI726 steel where an increased boron content of 0.025% caused cracks to form in the base metal at the seam and sometimes even in the weld metal. The following conclusions are drawn: The new method of electron-beam welding in a vacuum must be used not only for refractory and chemically active metals but also for heat-resistant austenitic steels and alloys. The electron-beam method gives welds much more resistance to crystallization cracks than other known welding methods. It is to be expected that the use of filler wire will make the electron-beam process applicable to a wider range of austenitic steels and alloys, and that the dagger shape of the seam will necessitate some modification of the design of the joints. There are 6 figures.

ASSOCIATION: Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki im. Ye. O. Patona AN USSR (Electric Welding Institute "Order of the Red Banner of Labor" im. Ye. O. Paton AS UkrSSR)

SUBMITTED: April 17, 1961

S/135/61/000/012/005/008
A006/A101

AUTHORS: Medovar, B. I., Doctor of Technical Sciences, Puzrin, L. G., Koshevoy, V. F., Engineers

TITLE: Automatic multi-pass submerged arc welding of 1X18H9T (1Kh18N9T) steel plates

PERIODICAL: Svarochnoye proizvodstvo, no. 12, 1961, 15-18

TEXT: Information is given on results of investigations carried out in 1958-59 by the Institute of Electric Welding and the "Krasnyy Kotel'shchik" Plant. The investigations were made for the purpose of developing a technology for automatic multi-pass submerged arc welding of longitudinal and circular seams on 60 - 90 mm thick 1Kh18N9T steel containers operating at temperatures not over 400°C. Various types of specimen were subjected to mechanical and corrosion tests to determine 1) the effect of self-hardening of the weld-metal on its mechanical properties; 2) anisotropy of the mechanical properties of the weld metal; 3) least critical time of holding the weld metal at 600 - 700°C until the metal suffers intercrystalline corrosion. It was found that the following materials and welding conditions yielded satisfactory results:

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Automatic multi-pass submerged arc welding ...

Grade Св-04Х19Н9 (Sv-04Kh19N9) and Св-04Х19Н9С2 (Sv-04Kh19N9S2) wire; flux АН-26 (AN-26) containing in %: SiO_2 30-32; CaF_2 20-24; CaO 5.0 - 6.5; MgO 16-18; Al_2O_3 20-22; MnO 2.5 - 3.5; FeO $\leq$ 1.0, S not over 0.07; P not over 0.10, and АНФ-14 (ANF-14) containing in %: SiO_2 14-16; CaF_2 60-65; CaO $\leq$ 8; MgO 4-8; Al_2O_3 10-12; FeO $\leq$ 1.0; S not over 0.07; P not over 0.02. Welding conditions were corrected by reducing current intensity and increasing welding speed, namely 550 amp for bead 1, 640 amp for bead 2 - 12; 720 amp for bead 13 and the following beads; arc voltage was 36 - 38 v, welding speed 25 m/hour. On the basis of the experimental investigation, satisfactory weld joints are obtained with Sv-04Kh19N9S2 wire with ANF-14 flux of dry granulation. It was furthermore found that during tensile tests at room temperature, anisotropy of the mechanical properties of multipass seams was practically absent. Only toughness was different for some specimens. This difference disappeared after austenization. The least critical time until the appearance of intercrystalline corrosion sensitivity is 30 min (at 600°C) after austenization for joints welded with Sv-04Kh19N9 wire under An-26 flux. There are 6 tables and 7 figures.

ASSOCIATIONS: Institut elektrosvarki imeni Ye.O. Patona, AN USSR (Institute of Electric Welding imeni Ye.O.Paton AS UkrSSR); Medovar, Puzrin, Koshevoy [Taganrogskiy zavod "Krasnyy kotel'shchik" (Taganrog "Krasnyy Kotel'shchik" Plant)]

Card 2/2

MEDOVAR, B.I.

S/125/61/000/001/008/016
A161/A133

AUTHORS: Vorob'yev, Yu.K., Doronin, V.M., Klyuyev, M.M., Topilin, V.V., Shiryayev, N.A., Voynovskiy, Ye.V., Medovar, B.I., Latash, Yu.V., Maksimovich, B.I.

TITLE: The effect of electro-slag remelting on th quality of chrome-nickel molybdenum ЭИ847 (EI847) steel

PERIODICAL: Avtomaticheskaya svarka, no. 1, 1961, 52-56

TEXT: The authors present the results of experiments carried out with arc furnace, vacuum furnace, and electro-slag processes. The chemical composition of the EI847 grade steel is (%): 0.10-0.15 C, 14-17 Cr, 14-16 Ni, 2.5-3.5 Mo, 0.45-0.85 Nb, not over 0.8 Si, 0.8 Mn, 0.02 S and 0.03 P. It is austenitic, is used mainly for seamless pierced and rolled tubes, and the ductility at high temperature is of primary importance. The austenitic structure of this steel is not subjected to $\gamma \rightarrow \alpha$ transformation at high cold deformation or any heat treatment. The surplus component is carboni-

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S/125/61/000/001/008/016
A161/A133

The effect of electro-slag remelting ...

trie. Cubic $Cr_{23}C_6$ carbide and the intermetallic $MoFe_2$ phase were revealed along with Nb carbonitride by X-ray analysis after long aging at 600-700°C. Aging for 500-7,000 hours at 550-700° does not cause any tendency to intercrystalline corrosion when EI847 steel is preliminarily hardened. The 100-hour strength limit for hardened EI847 steel is 25 kg/mm² at 650°, and 30 kg/mm² at 600°. In the tests electro-slag remelting was carried out in a Р-909 (R909) unit, in a 250 mm diameter crystallizer; the consumable electrodes were forged rods 140 mm in diameter, cleaned with emery wheel. No defects of any kind were found in ingots prepared by electro-slag remelting (Fig.2). Ingots produced by arc remelting in the vacuum were nearly as sound. The presence of globular inclusions is apparantly due to the high contamination of the initial metal before remelting. The steel produced by electro-slag and vacuum remelting had a higher ductility than steel melted by any arc furnace process (Fig.4); electro-slag remelted steel was less subject to overheating (its ductility remained at same level up to 1,300°C. Conclusions: 1) Purest (from nonmetallic inclusions) EI847 steel melted in arc furnaces was obtained in the process with a fresh charge with rimming and slag deoxidation by aluminum powder, and by employing Ni-Nb alloys, or ferroniobium with a low Si content. This process ensures the best ductility of the steel

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A161/A133

The effect of electro-slag remelting ...

at high and ordinary temperatures. 2) If very high purity is required the EI847 steel must be melted using either the electro-slag or vacuum arc remelting with consumable electrodes. Both these methods result also in the highest technological ductility. 3) Ingots produced with the electro-slag process differ from ordinary ingots by a more dense structure, absence of pipes, loose center structure, segregation and other defects. 4) The ultimate strength of EI847 steel slightly decreases after electro-slag remelting, and the yield limit increases. The higher yield limit is due to a decreased dendritic heterogeneity owing to the particular crystallization conditions in water-cooled copper ingot molds. There are 4 figures.

ASSOCIATION: Ordena Lenina zavod "Elektrostal'" im.I.F.Tevosyana (Order of Lenin "Elektrostal" Plant im.I.F.Tevosyan) - Yu.K. Vorob'yev, V.M. Doronin, M.M. Klyuyev, V.V. Topilin, N.A. Shiryayev, Ye. V. Voynovskiy; Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki im.Ye.O.Patona ("Order of the Red Banner of Labor" Electric Welding Institute im.Ye.O.Paton AS UkrSSR) - B.I. Medovar, Yu.V. Latash and B.I. Maksimovich

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S/125/61/000/003/009/016
A161/A133

AUTHORS: Safonnikov, A.N.; Medovar, B.I.; Kontorovich, L.Ye.; Khimushin, F.F.

TITLE: Heat-resistant ЭИ703 (EI703) alloy welded by electro-slag process with plate electrodes

PERIODICAL: Avtomaticheskaya svarka, no. 3, 1961, 68 - 74

TEXT: The EI703 alloy is a substitute of the ЭИ435 (EI435) and ЭИ602 (EI602) nickel alloys used for combustion chambers and rings in gas turbines. It has a slightly higher heat-resistance at high temperatures than EI435 and nearly the same as EI602, and a high ductility. Its chemical composition is the following: 0.06 - 0.12% C, ≤0.8% Si, ≤0.7% Mn, ≤0.020% S, ≤0.030% P, 20 - 23% Cr, 35 - 40% Ni, 2.5 - 3.5% W, 0.7 - 1.2% Ti, or 1.2 - 1.7% Nb, ≤0.5% Al, 0.05% Ce. The article presents details of electro-slag welding tests with EI703 alloy forgings with 120 by 120 mm cross section area, produced by the "Elektrostal'" Plant. Plate electrodes used as filler metal had the same width as the forgings being joined, and 12 to 18 mm thickness. The welding equipment consisted of a A-550 apparatus and a ТШС-3000/1 (TShS-3000/1) transformer. The A-550 welder permit-

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Heat-resistant ЭИ703 (EI703) alloy welded by....

ting plate electrode feed variations in a range of from 0.9 to 17 m/h had been described (Ref. 2: Opyt vnedreniya avtomata A-550 dlya elektroshlakovoy svarki plastinchatym elektrodom. Avtomaticheskaya svarka, no. 11, 1959). Four types of flux were tried: three fused fluoride type АНФ-6 (ANF-6), АНФ-7 (ANF-7), and АНФ-14 (ANF-14) and nonfused АНФ-1 (ANF-1) (fluorite concentrate). The latter flux proved not suitable for the EI703 alloy because of a dangerous defect - the weld metal did not fuse with the base metal. [Abstracter's note: The chemical composition of the fluxes is not given.] The following welding technology is recommended as a result of experiments welding the EI703 alloy with EI703 plate electrodes and the base metal dimensions as above (120 x 120 mm): plate electrode 12 by 120 mm; 1,500 ÷ 2,000 amp; plate electrode feed velocity 2.2 ÷ 2.5 m/h; starting voltage 33 v; voltage in established process 28 ÷ 31 v; either ANF-14 or ANF-7 flux; flux quantity of 300 g; slag pool depth of 18 mm; gap between welded elements 40 mm. The soundness of joint is illustrated in a photo. The mechanical strength of welds was slightly lower than that of the base metal, but the heat resistance was close to the one required by specifications. It is stressed that the required quality of welded joints is only possible when the prescribed process technology is followed strictly. Hot cracks are possible when the metal pool is deep. The rupture strength of the welded joints amounted to

Heat-resistant 703 (EI703) alloy welded by....

about 75% of the heat resistance of base metal. Technician B.R. Kleinerman is mentioned having participated in the tests. There are 6 figures, 3 tables and 4 Soviet-bloc references.

ASSOCOATIONS: Ordena Trudovogo Krasnogo Znanemi Institut elektrosvarki imeni Ye. O. Patona AN USSR ("Order of the Red Banner of Labor" Electric Welding Institute im. Ye.O. Patona AS UkrSSR) (A.N. Safonnikov and B.I. Medovar); L.E. Kontorovich and F.F. Khimushin (Moscow)

SUBMITTED: June 8, 1960

Card 3/3

S/125/61/000/004/013/013
A161/A127

AUTHORS: Medovar, B. I., Safonnikov, A. N.

TITLE: Effect of the metal pool shape on the hot shortness of welds during the electro-slag welding of austenitic steels and alloys

PERIODICAL: Avtomaticheskaya svarka, no. 4, 1961, 87 - 88

TEXT: Brief general information is given on the effect of the metal pool shape factor (depth/width ratio) on the hot-crack resistance of welds. Welds with a low shape factor (deep but narrow pool), in which the crystallites meet by their face ends or at obtuse angles, have a relatively low crack resistance, and cracks are usually located along the weld axis. No hot cracks are forming, as a rule, in welds with a high shape factor (shallow and wide pool). The behavior of austenitic steels and alloys is similar. For instance, the resistance of the weld metal to hot (crystallization) cracks varies over a wide range in the electro-slag welding of refractory austenite-alloy forgings 120 by 120 mm with plate electrodes. The shape of the metal pool can be changed by changing the process. In welding with a plate electrode, the shape factor increases with the increasing gap width, voltage, electrode thickness, slag pool depth (to a certain limit), and with a de-

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A161/A127

Effect of the metal pool shape on the...

creasing welding current. Two process variations for welding 120 x 120 mm forgings are given in a table:

Gap width, mm	I_{weld}, amp	U, volt	Shape factor	Crystallization cracks
30	3,800	25	0.6	Present
40	2,000	28	3	Absent

Note: Electrode thickness was 10 mm and slag pool depth 15 mm in both cases. The metal pool in the first process variation is deep but not wide, and crystallization cracks result. In the second variation, the metal pool is shallow but very wide, and the resistance to crystallization cracks is increased. There are 2 figures. [Abstracter's note: Essentially complete translation]

S/125/61/000/005/015/016
A161/A127

AUTHOR: Medovar, B. I.

TITLE: Consultation

PERIODICAL: Avtomaticheskaya svarka, no. 5, 1961, 93 - 94

TEXT: The author replies to the question "What new wires are available for welding high-alloy steels and alloys?" asked by welders from Sverdlovsk, Novocherkassk, Balashikha, Zelenodol'sk, Voronezh, Ufa, Podol'sk, Chirchik and more places. Institut elektrosvari im. Ye. O. Patona AN USSR (Electric Welding Institute im. Ye. O. Paton AS UkrSSR) has developed during 1959 - 1960 and tested with success in industrial use new welding wire grades produced of austenite-ferritic and austenitic steels and alloys: ЭП87 (EP87), ЭП89 (EP89), ЭП156 (EP156), ЭП88 (EP88), ЭП155 (EP155) and ЭП163 (EP163). The austenite-ferritic EP87 according to the ЧМТУ/ЦНИИЧМ-168-59 (ChMTU/TsNIIChM-168-59) specification, of 06Х25Н12ТЮ (06 Kh25N12TYu) grade is intended for the automatic submerged-arc welding of double-layer steel, i.e. Ст.3 + 06Х13 (St.3 + 06Kh13) and Ст.3 + 1Х18Н9Т (St.3 + 1Kh18N9T) from the stainless side. In combination with АН-26 (AN-26) flux it produces a weld metal that is resistant to intercrystalline corrosion and hot cracks, and has the

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required mechanical properties. Austenite-ferritic EP 87, per same specification, 05Х20Н11М3ТБ (05Kh20N11M3TB) is for automatic submerged-arc welding of acid-proof Х18Н12М2Т (Kh18N12M2T) and Х18Н12М3Т (Kh18N12M3T) steel, to be used with АНФ-5 (ANF-5) flux. It produces welds with a high corrosion resistance and may be used for ЭА1МБ (EA1MB) type electrodes. Austenite-ferritic EP156, according to ЧМТУ/ЦНИИЧМ-276-60 (ChMTU/TsNIIChM-276-60) specification, 08Х20Н9С2БТЮ (08Kh20N9S2BTYu) grade, is for CO_2 welding of 1Х18Н9Т (1Kh18N9T) steel, produces metal highly resistant to intercrystalline corrosion. Pure-austenite EP88 wire, as per ChMTU/TsNIIChM-169-59, 08Х15Н23Г7В7М2 (08Kh15N23G7V7M2) grade has been suggested as substitute for ЭИ395 (EI395) and ЭИ859 (EI859) or Х16Н26М6А (Kh16N26M6A) as well as Св-10Х16Н25М6 (Sv-10Kh16N25M6) (per GOST 2246-60). It produces welds highly resistant to hot cracking in the submerged-arc and argon arc process. The EP88 is good for refractory steel and alloys and for joining different steel. It is suitable for coated electrodes. Pure-austenite EP155, per ChMTU/TsNIIChM-275-60, grade 20Х22Н15Г7ТА (20Kh22N15G7TA), is for the submerged-arc, argon arc and CO_2 welding of scale-resistant (refractory) steels of Х25Н20 (Kh25N20) type, for instance the ЭИ417 (EI417) and ЭИ835 (EI835) grades. Higher carbon and nitrogen content in it at a limited chromium content ensures a minimum tendency of the weld metal to em-

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Consultation

brittlement through the formation of the sigma-phase. This wire may be employed for coated electrodes as well. Pure-austenitic EP163, per ChMTU/TsNIIChM-283-60, grade 08X15H30Г7B3T (08Kh15N30G7V3T), is intended for welding refractory steels of the X15H35 (Kh15N35) type, for instance ЭИ612 (EI612) or ЭИ725 (EI725). It contains a minimum of silicon and phosphorus in combination with higher manganese content, and ensures a high resistance of welds to hot cracking. The EP88, EP155 and EP163 wires have to be used in combination with fluoride fluxes such as АНФ-5 (ANF-5), АНФ-6 (ANF-6), АНФ-17 (ANF-17) or other. [Abstracter's note: Complete translation]

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MEDOVAR, B.I.; NAZARENKO, O.K.; GUREVICH, S.M.; CHEKOTILO, L.V.; POVOD, A.G.; PINCHUK, N.I.

Some characteristics of the electron-beam welding of austenite steelsand alloys. Avtom.svar. 14 no.7:79-81 Jl '61. (MIRA 14:7)

1. Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki im. Ye.O.Patona AN USSR.
(Steel--Welding) (Electron beams)

29051

12300

S/125/61/000/010/011/014
D040/D112

AUTHORS: Medovar, B.I.; Chelotilo, L.V.

TITLE: Tantalum - a new means for preventing hot cracks in welding stable-austentic steels and alloys

PERIODICAL: Avtomaticheskaya svarka, 14 no. 10, 1961, 88-90

TEXT: It has been discovered in experiments at the Institut elektrosvarki im. Ye.O.Patona (Electric Welding Institute im. Ye.O.Paton) that alloying with tantalum increases the resistance to hot cracking in stable-austenite weld metal. For this discovery an author's certificate with a priority of November 14, 1960, has been awarded. The experiments were conducted with butt and T-weld specimens of austenitic heat-resistant ЭИ 725 (08Х15Н37В5ТР) (EI725 [08Kh15N37V5TR]) alloy, 04Х15Н37В5Т (04Kh15N37V5T) welding wire, and АНФ-5 (ANF-5) fluoride flux, using a current of 300 amp and 28 v and a welding speed of 16 m/hr. Hot cracks formed when no tantalum was added; no cracks formed when a tamtalum wire or tape (3.5% of the metal) was laid

Tantalum - a new means ....

along the welding line. Sound T-welds without hot cracks were obtained by the addition of 5% of tantalum, and the test fracture was dull and fibrous, which indicates disoriented structure; when no tantalum was added, a longitudinal through crack formed, and the fracture structure was coarse. The positive effect of tantalum introduced into an austenitic weld may be explained by its peculiar influence on the nature of the primary crystallization of the welding pool. It turns the oriented transcrystalline structure into a disoriented refined structure due to the formation of a large number of primary carbides serving as crystallization centers. Besides this, addition of tantalum into the welding pool apparently promotes the formation of primary intermetallic compounds which also have a powerful structure-refining effect. The positive effect of tantalum may be also utilized in welding heat-resistant austenitic nickel-base alloys. The article includes micrographs of the metal structure. There are 3 figures. [Abstracter's note: essentially complete translation].

S/125/61/000/011/007/012
D040/D113

AUTHORS: Medovar, B. I., Latash, Yu. V., and Stupak, L. M.

TITLE: The possible oxygen sources and methods of oxidation protection for metal in electro-slag remelting

PERIODICAL: Avtomaticheskaya svarka, 14 no. 11, 1961, 47-52

TEXT: Three reasons for oxygen entering the metal in the electro-slag remelting process are pointed out and discussed: unstable oxides which may be present in the CaF_2-system fluxes used for the process can cause oxidation of some elements; scale or rust on the consumable electrode may introduce a large quantity of oxygen, which is illustrated by examples of very high porosity in remelted armco steel; oxygen from ambient air above the slag can get into the metal under the slag in two ways - through oxidation of the electrode surface and directly through the slag layer by the formation of high oxides of iron, titanium, manganese and other elements, and subsequent transformation of high oxides into low on the slag-metal interface. Argon protection proved effective in experiments at the Institut elektrosvarki (Electric Welding Institute) and the zavod "Dneprospetsstal'" ("Dneprospets-

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The possible oxygen ...

stal!" Plant) and eliminated "catastrophic oxidation" of the 79 HM (79NM) Ni-Mo alloy used in electrical engineering. It is stressed that scale may form on the entire electrode surface and not only close to the slag bath. A special paste of sodium aluminate with 20% calcium fluoride spread on electrodes prevents scale. Other protective coatings may also be used, e.g. graphite or varnish are good for copper and copper alloys as well as for steel with high carbon content. The following protective measures should be taken: (1) Use of fluxes free of oxides which could be reduced by elements in the steel being remelted; (2) obligatory cleaning or pickling of the surface of the consumable electrode; (3) if the steel to be remelted has a low oxidation resistance at high temperature, the entire electrode surface must be protected by a coating, or remelting must be conducted in a chamber filled with neutral gas and encompassing the entire electrode; (4) oxidation of an electrode heated by electric current is to be prevented by using the shortest throat possible, i.e. the current carrier is to be moved closer to the melting space; (5) protection of the slag bath by blowing argon or other neutral gas into the crystallizer. There are 6 figures and 5 Soviet references.

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D040/D113

The possible oxygen ...

ASSOCIATION: Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki im. Ye. O. Patona AN USSR (Electric Welding Institute "Order of the Red Banner of Labor" im. Ye. O. Paton of the AS UkrSSR)

SUBMITTED: March 25, 1961

Card 3/3

31441

1 2300

S/125/61/000/012/005/008
D040/D112

AUTHORS: Medovar, B.I., and Lutsyuk-Khudin, V.A.

TITLE: The problem of local failures of welded joints in austenitic steels

PERIODICAL: Avtomaticheskaya svarka, no. 12, 1961, 45-55

TEXT: The authors discuss the causes of local failure in the heat-affected zone, and concentrated intercrystalline corrosion at the fusion line in austenitic-steel welds subjected to temperatures over 580-600°C for a long period. These local failures mostly occur in steam piping made of such steel as Х18Н12Б (Kh18N12B) used abroad and Х18Н12Т (Kh18N12T) used in the USSR. A new laboratory test method is suggested for estimating the tendency of austenitic steel to such failures. The new method is much faster than existing methods, such as those used in the USA and Great Britain. The method uses a specimen consisting of plates of austenitic steel and carbon steel which are welded together by electro-slag welding with the aid of two electrode wires of low-carbon steel. The behavior of austenitic 18-8 type steel containing titanium and niobium, i.e. 1Х18Н9Т (1Kh18N9T) and Х18Н11Б

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(Kh18N11B) steel, was studied with such specimens. The test specimens also included 1Kh14N14B3M(1Khl4N14V3M) Cr-Ni-W-Mo, EI257 (EI257) pipe steel, taken from a piece of steam pipe that failed in service after 14,136 hours at the Cherepetskaya GRES (Cherepet' State District Power Plant); the pipe was supplied by Yu.M. Nikitin of TsNIITMASh. Intercrystalline corrosion was found in all specimens which were prone to local failure in the heat-affected zone; it is supposed that the tendency to local failures at temperatures above 580-600°C and the tendency to shearing corrosion are caused by the very same factors. It was therefore recommended to use the same means to prevent local failures of the austenitic-steel welds as are used against shearing corrosion, e.g. excluding Ti and Nb from the steel composition, or raising their content to a level sufficient to prevent segregation of the Cr carbides even after overheating; producing a bi-phase austenite-ferritic structure in the heat-affected zone; reducing the carbon content down to the limit of its solubility in austenite at 550-800°C; improving the purity of grain boundaries in austenitic steel by improving the steelmaking processes, which could be achieved by electro-slag remelting, for example, particularly in the case of

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steel containing Ti and Nb. Engineers V.Ya. Sayenko, L.G. Puzrin, G.A. Pavliychuk and N.I. Pinchuk took part in the experimental investigation. K.V. Lyubavskiy is also mentioned. There are 8 figures, 2 tables and 22 references: 9 Soviet and 13 non-Soviet-bloc. The four most recent references to English-language references read as follows: R.N. Younger, R.G. Baker, Heat-affected zone cracking in welded high-temperature austenitic steels, "Journ.Iron and Steel Inst.", v. 196, p. 2, Oct. 1960; R.J. Truman, H.W. Kirkby, Some ductility aspects of 18-12-1Nb steel, "Journ. Iron and Steel Inst.", v. 196, p. 2, Oct. 1960; K.J. Irvin, J.D. Murray, F.B. Pickering, The effect of heat-treatment and microstructure on the high-temperature ductility of 18% Cr - 12% Ni - 1% Nb steels, "Journ. Iron and Steel Inst.", v. 196, p. 2, Oct. 1960; N.E. Moore, J.A. Griffiths, Microstructural causes of heat-affected zone cracking in heavy section 18-12-Nb austenitic stainless steel welded joints, "Journ. Iron and Steel Inst.", v. 197, p. 1, Jan. 1961.

ASSOCIATION: Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki im. Ye.O.Patona AN USSR (Electric Welding Institute "Order of the Red Banner of Labor" im. Ye.O.Paton, AS UkrSSR)

SUBMITTED: August 4, 1961

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OSTROVSKIY, S.A., kand. tekhn. nauk; RABKIN, D.M., kand. tekhn. nauk; MAKARA, A.M., kand. tekhn. nauk; SHEVERNITSKIY, V.V., kand. tekhn. nauk; ASNIS, A.Ye., kand. tekhn.nauk; POKHODNE, I.K., kand.tekhn. nauk; PODGAYETSKIY, V.V., kand.tekhn.nauk; PATON,B.Ye., laureat Leninskoy premii, akademik, doktor tekhn. nauk; BEL'FER,M.G., inzh.; MANDEL'BERG,S.L., kand.tekhn.nauk; MEDOVAR,B.I., doktor tekhn.nauk; GUREVICH,S.M., kand.tekhn.nauk; LATASH,Yu.V., kand.tekhn.nauk; KIRDO, I.V., kand.tekhn.nauk; SOROKA,M.S., red.; GORNOSTAYPOL'SKAYA, M.S., tekhn.red.

[Technology of electric fusion welding]Tekhnologiia elektricheskoi svarki plavleniem. Moskva, Mashgiz, 1962. 663 p. (MIRA 15:12)

1. Nauchnyye sotrudniki Instituta elektrosvarki imeni Ye.O.Patona (for all except Soroka, Gornostaypol'skaya).
(Electric welding)

MEDOVAR, B.I., doktor tekhn.nauk; CHEKOTILO, L.V., inzh.

Single-pass submerged-arc welding of stabilized austenitic steel. Mashinostroenie no.2:55-57 Mr-Ap '62. (MIRA 15:4)

1. Institut elektrosvarki im. Ye.O.Patona AN USSR.
(Electric welding)

PATON, B.Ye., akademik; MEDOVAR, B.I., doktor tekhn.nauk; LATASH, Yu.V., kand.tekhn.nauk

Present state and prospects for the further development of electric slag refining in the Ukraine. Met.i gornorud.prom. no.5:12-19 S-O '62. (MIRA 16:1)

1. Ordena Trudovogo Krasnogo Znameni Institut elektrosvarki imeni Ye.O.Patona AN UkrSSR. 2. Akademiya nauk SSSR (for Paton).

(Zone melting) (Ukraine--Steel--Metallurgy)

37665
S/125/62/000/004/002/013
D040/D113

12300

AUTHORS: Medovar, B.I., Latash, Yu.V., Stupak, L.M., and Maksimovich, B.I.

TITLE: Dephosphorizing the metal during electroslag remelting

PERIODICAL: Avtomaticheskaya svarka, no. 4, 1962, 6-7

TEXT: The dephosphorizing effect of different slag systems is briefly discussed from the ionic theory viewpoint, and slag systems are recommended for electroslag remelting of carbon steel and alloy steels. The high affinity of BaO with P_2O_5, its advantages compared to CaO, and the disadvantages of SiO_2 and Al_2O_3 are indicated. Fluxes of CaF_2-CaO-FeO, CaF_2-BaO-Fe_3O_4 and CaF_2-BaO-Mn_2O_3 systems are recommended for remelting carbon steel, and non-oxidizing CaF_2-BaO systems for alloy steels. It is recommended (1) to keep the slag bath temperature low when dephosphorizing, (2) not to use CaF_2,

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CaF_2-Al_2O_3 and CaF_2-CaO slags, and (3) to cast ingots with a subnormal height:diameter ratio if the phosphorus content has to be reduced, since, using present remelting techniques, the slag cannot be skimmed and renewed. The АНФ-20 (ANF-20) flux (CaF_2-BaO system) can be used for dephosphorizing steel containing Ti, Al and other elements with a high affinity with oxygen. In remelting 1Х18Н9Т (1Kh18N9T) steel with an ANF-20 flux, 85-90% Ti is assimilated by the metal bath. The phosphorus content in Г 13 (G13) carbon steel could be reduced from 0.068 to 0.05%, from 0.077 to 0.065%, and from 0.077 to 0.063% by three different fluxes.

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SUBMITTED: December 30, 1961

36074
S/135/62/000/004/007/016
A006/A101

18.1111

AUTHORS: Medovar, B. I., Doctor of Technical Sciences, Chekotilo, L. V., Pinchuk, N. I., Lutsyuk-Khudin, V. A., Engineers

TITLE: Intercrystalline weld-adjacent cracks in welding austenite steels and alloys

PERIODICAL: Svarochnoye proizvodstvo, no. 4, 1962, 17-21

TEXT: The authors, with the participation of engineer L. G. Puzrin, present some concepts on the formation of weld-adjacent intercrystalline cracks in flash-welding of austenite steels and alloys. During this process the following types of crack may arise: 1) crystallization cracks extending into the weld, or originating in the weld; 2) cracks along the fusion line at a distance from one to several grains; 3) cracks along the linear clusters of intermetallic and nonmetallic impurities. An effective means of preventing crystallization cracks in heat-resistant austenite steels, is to raise the boron content in the weld metal, for the purpose of increasing the quantity of boride eutectics, which is able to close-up weld-adjacent cracks. To prevent cracks which run at an equal distance from the fusion line, it is imperative not t...

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allow superheating of the base metal and slow cooling in the temperature range of least resistance of the gamma-solid solution. Changes in the chemical composition of the steel or alloy, and, first of all, a reduced carbon content and the development of a second phase in the structure, should help to prevent the formation of weld-adjacent cracks of this type. To prevent cracks along linear clusters of impurities, it is necessary to use for stressed parts a metal that had been subjected to electric slag remelting in order to raise sharply its micro-homogeneity. Electric slag remelting is simultaneously a reliable means of preventing weld-adjacent crystallization cracks. There are 7 figures and 12 references: 9 Soviet-bloc and 3 non-Soviet-bloc.

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41586
S/125/62/000/011/001/003
/2300 D040/D114

AUTHORS: Paton, B.Ye., and Medovar, B.I.

TITLE: Improving the quality of steels and alloys for critical weldments

PERIODICAL: Avtomaticheskaya svarka, no. 11, 1962, 1-7

TEXT: Three metal refining methods - (1) electroslag remelting, (2) melting by electron beam in vacuum, and (3) the Perrin process which is claimed to have been initially developed by A.S. Tochinskiy in the USSR - are discussed in connection with the dependability of weldments in pressure vessels, hulls of sea-going ships, etc. Recent experiments of TsNIIChM with the Perrin-Tochinskiy slag refinement process at large Soviet metallurgical plants and Soviet achievements in metal refinement are quoted. Extensive research into the use of the Perrin process for various steel grades, such as common carbon steel, low-alloy grades for pipelines, boiler steel, bridge steel, etc., is considered necessary. It is suggested to employ slag refinement in the continuous casting process, and recommended (1) to use electroslag remelting for special steel grades and alloys, and

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electron-beam vacuum melting for pure metals, (2) to improve the weldability of carbon and alloy steels by synthetic slag refining, and (3) to prefer the electroslag process for cases when carbon steel or alloy steel is to be used for particularly oritical weldments. There are 5 figures.

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SUBMITTED: July 5, 1962

MEDOVAR, B.I., doktor tekhn.nauk; CHEKOTILO, L.V., inzh.

Manganese fluoride flux for the welding of austenitically stable steel and alloys. Svar. proizv. no.8:17-19 Ag '62. (MIRA 15:11)

1. Institut elektrosvarki im. Ye.O.Patona.
(Steel, Stainless--Welding)
(Flux (Metallurgy))

MEDOVAR, B.I., doktor tekhn.nauk; CHEKOTILO, L.V., inzh.; KUMYSH, I.I., inzh.

Fused carbide fluxes for the welding of austenitically stable steels and alloys. Svar. proizv. no.8:19 Ag '62. (MIRA 15:11)

1. Institut elektrosvarki im. Ye.O.Patona.
(Flux (Metallurgy)) (Steel, Stainless—Welding)

MEDOVAR, B.I., kand.tekhn.nauk; PINCHUK, N.I., inzh.; PUZRIN, L.G., inzh.

Effect of phosphorus on the stress-rupture strength of joints in welded Kh18N9T steel. Metalloved. i term. obr. met. no.8:24-25 Ag '62. (MIRA 15:11)

1. Institut elektrosvarki im. Ye.O.Patona AN UkrSSR.
(Steel alloys—Welding) (Welding—Testing)

1 2300

32960
S/125/62/000/001/007/011
D036/D113

AUTHORS: Safonnikov, A.N.; Medovar, B.I. (see Association); Kont ...vich, L.Ye.; Khimushin, F.F. (Moscow)

TITLE: Electroslag welding of VZh100 (EP126 brand) iron-chrome-nickel heat-resistant alloy by a plate electrode

PERIODICAL: Avtomaticheskaya svarka, 15 no. 1, 1962, 59-63

TEXT: The authors describe the technology developed for the electroslag welding of ВЖ100 (VZh100) (ЭП126 [EP126]) brand iron-chrome-nickel heat-resistant alloy by a plate electrode. This alloy, which contains less nickel than the ЭИ703 (EI703) alloy, is recommended for parts working at high temperatures and under considerable loads; the chemical composition is as follows: (in %) 0.04 C, 0.51 Si, 0.27 Mn, 19.6 Cr, 27.8 Ni, 4.78 W, 2.90 Mo, 1.05 Nb, 0.2 N_2, 0.008 B. The electroslag welding experiments were carried out with 90 x 90 mm forgings by means of 90 x 700 mm forged plate electrodes whose thickness varied from 12 to 35 mm. The welding conditions were as follows: welding current - 1,200-6,000 amps and 20-40 v, electrode feed - 0.9-5.0 m/hr, depth of slag pool - 10-22 mm. АНФ-6 (ANF-6), АНФ-7 (ANF-7)

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and AHF-14 (ANF-14) welding fluxes were tried. The butt-joint gap varied from 30 to 42 mm. Preliminary tests showed that welding with large currents and low voltages caused hot crystallization cracks to form in the weld metal. Increasing the voltage when welding with ANF-6 flux sometimes led to the appearance of slight cold shuts and slag inclusions in the weld metal and along the fusion line. Perfect welds were obtained with ANF-14 and ANF-7 fluxes under the following welding conditions: welding current - 1,500-1,800 amps; electrode feed - 2-3.5 m/hr; idle-run voltage - 33 v; welding voltage - 30 v; gap - 36 mm; depth of slag pool - 22 mm; thickness of plate and electrode - 12 mm. After heat treatment, the hardness of the weld metal approached that of the base metal. When a VZh100 electrode was used the ultimate strength and yield limits of the weld metal at room temperature were 80% of the limits of the base metal; for extension and contraction this percentage was 50-60% and for toughness - 40%. At 650°C the ultimate strength of the weld metal was about 80% of that of the base metal while the extension and contraction values of the weld metal approached those of the base metal. Tests for long-term heat-resistance showed that the weld metal was not inferior to the base metal in this respect. The conclusions made, are as follows:

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Electroslag welding of ...

lows: (1) A technology has been developed for the electroslag welding of VZh100 alloy. Cracks in the weld metal can be avoided only by adhering strictly to the welding conditions resulting in a relatively shallow and wide welding pool; (2) Hot cracks may appear in the weakness zone when welding VZh100 alloy. Further research is needed to establish the necessity of preliminary electroslag remelting of the base metal to eliminate this tendency; (3) The long-term heat-resistance of the welds is equal to that of the base metal. Technician B.R. Kleynerman took part in the tests. There are 4 figures, 3 tables and 1 Soviet reference.

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(Safonnikov, A.N. and Medovar, B.I.)

SUBMITTED: March 16, 1961.

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